PHYTOTOXICOLOGY SECTION INVESTIGATION IN THE VICINITY OF GENERAL MOTORS FOUNDRY, ST. CATHARINES, ONTARIO AUGUST 15, 1989

APRIL 1991

Ontario
Environment
Environnement

ISBN 0-7729-8225-2

PHYTOTOXICOLOGY SECTION INVESTIGATION

IN THE VICINITY OF

GENERAL MOTORS FOUNDRY, ST. CATHARINES, ONTARIO

AUGUST 15, 1989

Report prepared by:

Air Resources Branch
Ontario Ministry of the Environment

APRIL 1991

Cette publication technique
n'est disponible qu'en anglais

1 Background

The General Motors Foundry in St. Catharines is the company's main facility in Canada for the manufacturing of automobile engines. The operation includes the recovery of metals from scrap. The foundry covers approximately 150,000 m^2 (15 ha). It is situated in a predominantly rural area with open fields and wooded areas to the north, south and east. A vineyard exists to the northeast beyond the old Welland canal. To the west is the Welland canal with an industrial area of St. Catharines beyond and residential areas to the northwest and the southwest. The prevailing winds in this area are very strongly from the southwest.

2 Methods

On August 15, 1989, Marius Marsh and Bill Gizyn of Phytotoxicology Section sampled silver maple foliage in triplicate from trees at 9 stations (see Figure 1) in the vicinity of the operation as well as at one remote control site approximately 6 km north of the foundry.

All samples were collected using standard Phytotoxicology sampling techniques (O.M.E., 1983). Samples were delivered to the Phytotoxicology Section sample processing laboratory in Toronto where they were dried and ground before being submitted to the Laboratory Services Branch Trace Inorganics Laboratory for chemical analysis. The samples were then analyzed for copper, nickel, iron, zinc, lead, cadmium, sodium, cobalt, molybdenum, manganese, chromium, aluminum, strontium, vanadium, arsenic, antimony, and selenium. No analyses for organic contaminants were conducted.

3 Results

On the day of the survey the wind was blowing from the southwest, and a noticeable organic odour was evident downwind from the foundry at Stations 2 and 3. Poplar trees within 500 m downwind from the factory were observed to be either dead or in a state of severe decline. However, numerous poplar trees which were well removed from the foundry and were unlikely to be influenced by its emissions were observed which exhibited similar signs of decline.

The results for copper, lead, zinc, iron, manganese, aluminum, sodium and strontium are presented in Table 1. Results for nickel, arsenic, cadmium, cobalt, chromium, molybdenum, antimony, selenium, and vanadium showed, at most, only trace amounts present.

Table 1. Elemental Concentrations (ppm) in Foliage in the Vicinity of General Motors Foundry, St.Catharines, Ont. Aug 15, 1989.

	Element							
Station	Cu	Pb	Zn	Fe	Mn	Al	Na	Sr
1	6.7	3.2	23	307	127	138	22	54
2	8.5	5.0	39	803	45	327	44	45
3	8.5	2.8	43	387	80	173	22	37
4	8.5	3.7	44	290	33	79	14	91
5	9.2	2.5	26	223	79	58	10	38
6	11	2.9	29	463	38	307	24	36
7	9.5	1.7	33	157	24	96	14	29
8	7.6	2.7	30	120	17	41	7	18
9	9.9	3.1	20	373	130	193	22	34
10	7.5	2.9	31	180	44	83	18	29
ULN[1]	20	30	250	500	-	500	50	-

[1] Upper Limit of Normal for rural foliage (unwashed). See Appendix 5.1 for explanation.

In order to understand the spatial distribution of some of these elements in relation to the foundry, concentrations of iron, aluminum, and zinc were plotted using a contour mapping program (Surfer, ver. 2.0). These contour maps, which are shown in Figures 2, 3, and 4, give an indication of a potential pattern of distribution of the specific contaminant; however, they should be interpreted with care since accuracy is only known at the ten sampling stations.

4 Discussion

At Station 2, the nearest station downwind from the foundry, the Upper Limit of Normal (ULN, see appendix for explanation) for iron is considerably exceeded. This indicates that the foundry is a major source of iron contamination to vegetation downwind. Figure 2 supports this conclusion and places the center of contamination in an area downwind according to the prevailing wind pattern. Although foliar aluminum concentrations do not reach the ULN downwind from the foundry, they are clearly higher than the control. Figure 3 shows the likely pattern of aluminum distribution to be similar to that of iron. For zinc (Fig. 4), concentrations near the foundry are only slightly above that of the control, and the foundry would not appear to be more than a minor source of zinc.

Figures 2 and 3 indicate that elevated levels of iron and aluminum in foliage extend well over one kilometer downwind from the foundry. Since this was the first year that an assessment survey has been conducted around the foundry, the station locations were selected to obtain a generalized assessment of the contaminant situation; however, the results indicate that the number of stations directly downwind from the plant is insufficient to determine the

precise location and the full extent of the affected area. It would appear that agricultural areas downwind from the foundry are receiving inputs of iron and aluminum considerably higher than normal for the area.

The results of this survey indicate that the General Motors foundry is a major source of iron and aluminum emissions and that levels of these metals are significantly elevated for as much as one kilometer downwind from the operation.

5 Appendices

5.1 Explanation of MOE "Upper Limits of Normal" Contaminant Guidelines

Interpretation of concentrations were made based on "Upper Limit of Normal" (ULN) guidelines established by the Phytotoxicology Section, Air Resources Branch (OME, 1989). The ULN was determined by examining an extensive database for soils and vegetation samples collected at sites removed from any point source of contamination. Statistical tests were applied to the data to calculate the ULN value. This ULN value would not normally be exceeded in 99 samples in 100 for background areas. Values which exceed the ULN are considered likely to have resulted from contamination. Values which exceed the ULN do not necessarily imply that the element is toxic at that level. Concentrations which are below the guidelines are not known to be toxic.

It is stressed that the ULNs do not represent maximum desirable or allowable levels of contaminants, but rather serve as guidelines which, if exceeded, flag situations requiring further investigation to determine the significance of the above normal concentrations. Comparisons of sample elemental concentrations with those from control or reference areas may also serve to flag such situations at contaminant concentrations lower than the ULNs.

5.2 References

Ontario Ministry of the Environment, 1983. Field Investigation Manual. Phytotoxicology Section, Air Resources Branch; Technical Support Sections - NE and NW Regions.

Ontario Ministry of the Environment, 1989. Ontario Ministry of the Environment "Upper Limit of Normal Contaminant Guidelines for Phytotoxicology Samples". Phytotoxicology Section - Air Resources Branch, ARB-138-88-Phyto. ISSN 0-7729-5143-8

Figure 1: Station Locations for Foliar Sampling
General Motors Foundry, St. Catharines, August 15,1989.

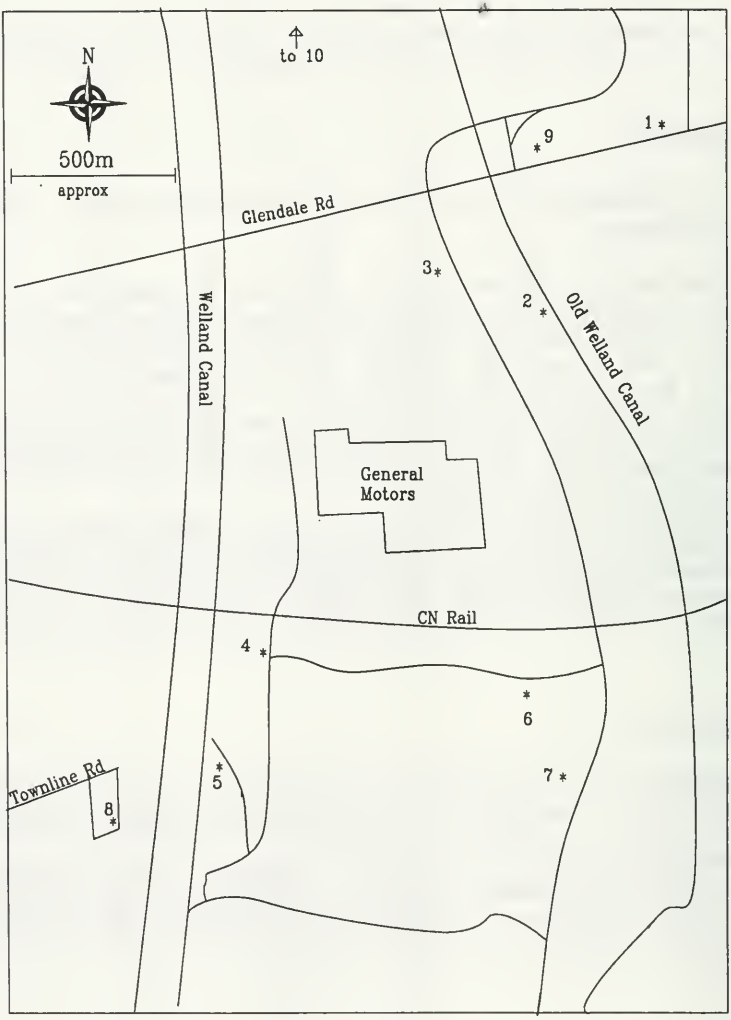

Figure 2: Contour Map of Foliar Iron Concentrations (ug/g) in Silver Maple Foliage Samples Collected in the Vicinity of the G.M. Foundry, St. Catharines, August 15, 1989.

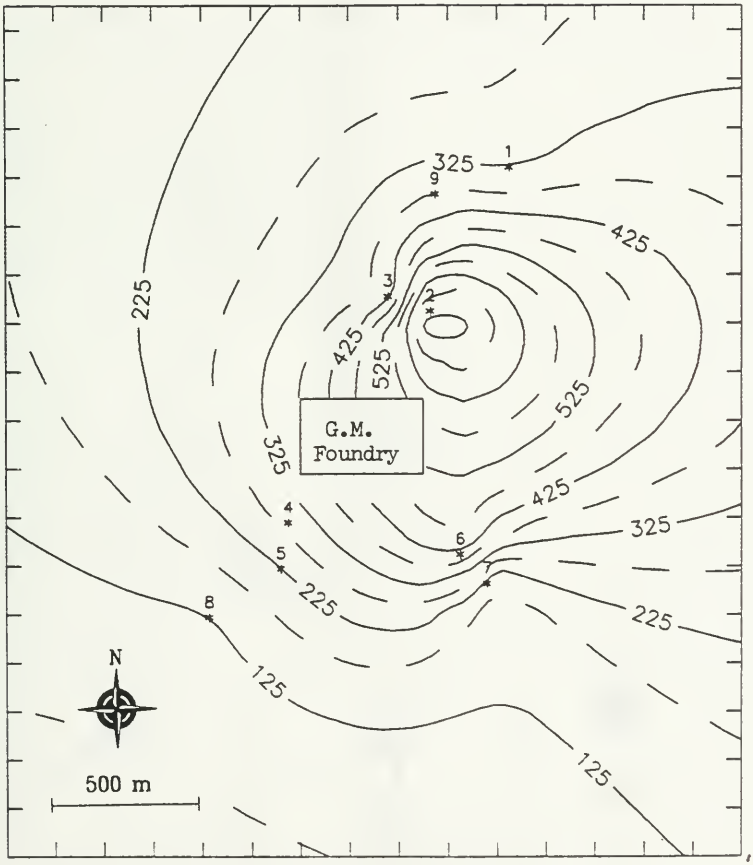

Figure 3: Contour Map of Foliar Aluminum Concentrations (ug/g) in Silver Maple Foliage Samples Collected in the Vicinity of the G.M. Foundry, St. Catharines, August 15, 1989.

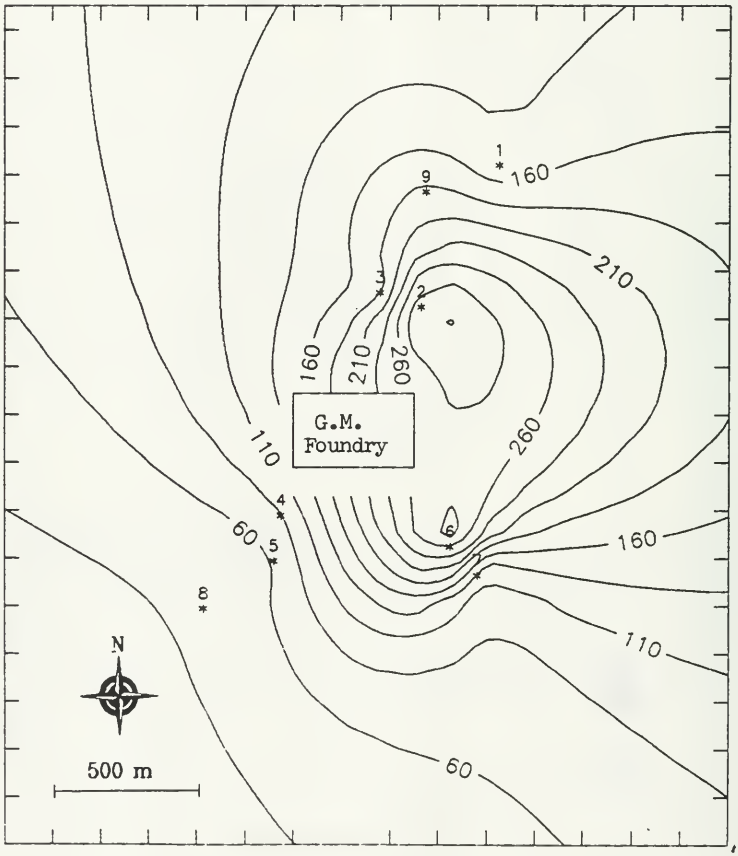

Figure 4: Contour Map of Foliar Zinc Concentrations (ug/g) in Silver Maple Foliage Samples Collected in the Vicinity of the G.M. Foundry, St. Catharines, August 15, 1989.